

## RESEARCH ARTICLE

# Application of Surveying and Mapping and Digital Technology

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**Abstract:** With the continuous development of the entire economy, society, and science and technology, the entire earth surveying and mapping technology is also constantly upgrading and developing. With the deepening of digitization, the development of digital surveying and mapping technology has gradually strengthened. Geographical surveying and mapping work plays an important role in the socio-economic development of the entire country and region. The essence and connotation of digital surveying and mapping technology is to serve geographic space and digital technology, and gradually develop to all aspects and deeper disciplines. In the surveying and mapping work, it is necessary to gradually improve the management of the entire digital surveying and mapping technology, continuously improve the service capabilities, and develop the entire surveying and mapping technology to a higher level.

**Keywords:** Surveying and mapping; Digital technology; Application

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## 1. The Application of Mapping and Digital Technology in Engineering Surveying

### 1.1 Analysis of Mapping Science and Digital Technology in Engineering Surveying

Due to the rapid development of digital surveying and mapping technology, it is widely used in engineering construction, which has a key role in the surveying work, such as GPS, remote control technology, etc. In the original measurement work, most of the work is done by manual, through their own calculation and measurement to complete this work, the disadvantage of such work is more time consuming and can not meet our requirements. The emergence of digital surveying and mapping technology to change this situation, by using this technology to analyze and process the data, automatic mapping, and traditional surveying and mapping, digital surveying and mapping technology obviously has great advantages. The rapid development of digital technology plays an important role in engineering construction, but in some aspects there are still some shortcomings, so its shortcomings should always be found in time to update the technology, so that this technology is more in line with the actual needs.

### 1.2 Analysis of the Advantages of Digital Mapping Technology

Compared with traditional surveying and mapping technology, digital surveying and mapping technology has a lot of advantages, and its importance in engineering surveying work is relatively obvious. After the application of digital mapping technology in engineering surveying, the accuracy of mapping has been greatly improved, and the degree of data processing has also increased a lot, which is essential for the effective management of engineering surveying data.

#### 1.2.1 Computer Simulation Aspects

Digital mapping technology in the specific application process, you can use the computer to measure the terrain, landform features and other related information more intuitive presentation to the relevant staff. Traditional surveying and mapping technology in the application process usually involves a large number of lines, numbers and other elements, and to judge the accurate meaning of the elements in the map, it requires its staff must have a high degree of professionalism, while digital surveying and mapping technology in the actual application of the staff's professionalism requirements are relatively weak, which effectively makes up for the shortcomings of traditional

technology.

### **1.2.2 Easier Storage**

After digital mapping technology is applied in engineering measurement, the storage and storage of digital products are very convenient, and the non-deformability of digital product information is also preserved, and the practicality of topographic maps in the process of engineering construction is greatly enhanced, which can effectively avoid the appearance of repeated measurements, greatly reduce the cost of engineering measurement, and the economic benefits are also improved. In addition, after the application of digital mapping technology in engineering measurement, topographic information storage is more convenient, data can be processed at any time, and the use of topographic information has been extended to fully meet the actual needs of customers.

### **1.2.3 Ability to Meet the Different Needs of Users and Contribute to Increased Automation**

For digital mapping products, different users have different needs, digital mapping technology can be combined with changes in customer demand, the implementation of the corresponding product reprocessing, and then fully meet the requirements of customers on the various elements of the product. At the same time, digital mapping products also have splicing, scaling and other functions, and through the scientific and reasonable splicing can continue to broaden the scope of application of its products. In addition, the use of digital mapping technology into a map, you can use the computer on the basis of this map, to achieve different designs and planning. At the same time, it can also be compared with other programs for analysis, so as to choose the best implementation plan. In the use of digital mapping technology for production, it is often necessary to use the computer to achieve, in this premise, the automation, accuracy and standardization of its production process will also continue to improve.

### **1.2.4 Graphical Information Enrichment**

Compared with traditional surveying and mapping technology, digital surveying and mapping technology is more accurate and specific in the coordinates mapped on the map, and the depiction is clearer, so that all the attribute information on the terrain points can appear comprehensively, while it is easier to call on the mapping symbols in the process of mapping, so that the drawing of the map terrain is more rich, comprehensive and standardized. It provides convenience for engineering measurement as well as mapping.

## **1.3 Application of Digital Mapping Technology in Engineering Surveying**

### **1.3.1 Applications of Digital Ground Mapping**

Digital mapping is incomparable to traditional analog mapping in terms of both advantages and development prospects. In surveying engineering, ground digital mapping technology has been widely used, mainly because of its relatively high accuracy of measurement. At the same time, because the ground digital mapping technology can well carry out the collection and storage of spatial data, graphic drawing, map output, and also can automatically produce digital maps with relatively high accuracy. In collecting field data, digital mapping can make use of two kinds of facilities: total station and GPS/RTK, which have different ways of data collection, and each of them has advantages and disadvantages. In comparison with the past, modern requirements for project quality have been continuously strengthened, so if only one of the two facilities is applied, it is no longer sufficient, so most of the time both measurement facilities are applied, usually the GPS/RTK is applied to implement the measurement, and the data obtained from the measurement can be applied in the total station. The values obtained from the total station measurements are also usually used to check the correctness of the GPS measurements, and because of the simultaneous application, the horizontal occlusion problem of the total station and the overhead occlusion problem of the GPS can be effectively solved, thus realizing the real complementary advantages.

### **1.3.2 Digital Mapping Technology Applications**

Digital photography technology is mainly through the use of computer technology with the image of digital processing and matching, and it is very close to the visual and information link, first can use the image of the three-dimensional surface model to create, and then according to the model of the actual situation of the graphic measurement and drawing. Nowadays, digital mapping technology can be divided into internal and external integration mode and electronic plate mode. The internal and external integration mode is to combine the relevant technology of internal and external industry together and apply it to the drawing of the map, and apply the total station and electronic handbook to the field data collection in the process of measurement. This mapping technology can greatly improve the accuracy of measurement and better improve the efficiency of work. Electronic plate mapping technology is in the drawing of the map, combined with the map of the existing relevant information, according to

the relevant requirements, the system automatically synthesized the relevant information, so as to present a new form of electronic map drawing. But this way because of the external environment and the actual terrain to examine the data error, will affect the reliability of the electronic mapping of the flat plate.

### 1.3.3 Application of Digital Imaging Technology in Engineering Surveying

Most of the digital imaging technology is applied in the large scale map measurement work, the application of spatial data collection and storage, graphic mapping, imaging output and other integrated mapping way to complete the mapping work. The accuracy of this method is relatively high, and it is widely used in engineering surveying. Digital surveying and mapping technology can apply one-time measurement to obtain the final mapping results, and through different scales of mapping, to meet the needs of different professionals for the application of maps, avoiding the development of repetitive measurement work. In the process of data collection, digital mapping technology can also achieve automatic collection, storage and processing of three-dimensional coordinates, eliminating errors caused by human involvement. In this regard, the reasonable application of digital imaging technology can not only improve the accuracy of mapping to go, but also save the investment of manpower and material resources. In general, as long as there is no strong magnetic field in the area, basically the application of digital imaging technology can be said to be any obstacle.

### 1.3.4 The Value of Digital Mapping Technology Embodied in Engineering Surveying

The embodied value of digital mapping technology in engineering surveying is mainly reflected in the following aspects: ① Remote sensing technology application in digital mapping technology. Remote sensing technology is a technology that refers to the sensing and detection of the mapping target through remote sensing instruments and so on, to obtain the real situation of the detection target, and to receive, extract, transform, analyze, process and apply the electromagnetic wave information of the target such as reflection and scattering. Due to the large area of mapped terrain, the need for simultaneous detection, digital mapping technology because of its comprehensive performance and wide range of application, has played an important role for engineering measurement; ② digital mapping technology through the global positioning system to mapping targets to do positioning operations, the collection of data to organize, analyze, extract mapping

data; ③ digital mapping technology. The application of mapping technology, you can map the data, map, table, text combination makes mapping technology more widely used and engineering measurement; ④ digital photogrammetry technology application. Digital surveying and mapping technology will combine photography and digital, the use of computer network technology for processing and mapping, the use of high-tech technology and methods of coordination and production. Digital mapping will be applied in a more realistic and practical way. The continuous improvement and updating of digital surveying and mapping technology provides convenient and effective value for this work of engineering surveying, and also provides convenient conditions for construction work.

The application of digital mapping technology in engineering surveying is conducive to improving the accuracy of mapping, providing more accurate map information, combining with modern technology, reducing the time and workload of staff, improving the efficiency of engineering surveying and reducing the cost of engineering surveying. The application of digital surveying and mapping technology is becoming more and more widespread, and digital surveying and mapping technology will continue to develop and better serve the development of society.

## 2. The Use of Digital Cadastral Mapping Technology

### 2.1 Advantages of Digital Cadastral Mapping Technology

Digital cadastral mapping technology allows for the digital and automated management of data and information. Digital mapping technology is used to capture, encode, transmit and store data, process the data and images, and then display them on a computer and print them out. Digital cadastral mapping products have higher technical content and are more accurate, and the digital mapping method can better reduce errors, can better save manpower and resources, and can help people to better manage the data. Digital cadastral surveying mainly uses computers to automatically record, process and generate pictures, in short, it has strong automation characteristics. In contrast, traditional cadastral surveying uses a combination of a latitude and longitude instrument and a protractor. By this way it is difficult to achieve high accuracy and is not suitable for the development of modern technology. The use of digital cadastral surveying also allows the data to be updated in a timely manner, so that the user is better informed about the latest data. Digital cadastral surveying by computer increases the efficiency of cadastral survey-

ing and makes the data more scientific and informative.

## 2.2 Operational Methods for Digital Cadastral Mapping

### 2.2.1 Control Measurements

For cadastral mapping, control measurement is also important. The main purpose of control measurement is to make the feature points and boundary points more accurate, which can make the accuracy of mapping controlled within a certain range and can guarantee the accuracy and precision of measurement data. Because of the development of GPS technology, so reduce the intensity of the measurement work, GPS control and flexible and simple conductor instead of the traditional triangulation method, can make the control work more efficient and concise, mainly because of the popularity of this GPS technology to make the cadastral measurement work more convenient and efficient. Control measurement is mainly divided into first-level control measurement and root control measurement. The first level control survey refers to the static GPS technology identification, and then use the random evaluation software in the strict leveling. Figure root control measurement mainly uses the combination of wire measurement and various rendezvous measurement. These two methods of control measurement can make the measurement data more accurate and more in line with the requirements.

### 2.2.2 Measurement of Fine Points

#### (1) Scanning and digitizing operations

The so-called scanning digitization operation refers to taking a survey map from a drawing, scanning it, and then coming up with a digital survey map, while in fact the real operation is not so simple and still has high requirements. The existing topographic or cadastral map must first be scanned and then a raster graphic is obtained, which is then scanned using professional scanning vectorization software, thus converting the raster graphic into a kind of vector graphic, so that the original cadastral map can be more digitized. But by scanning the original cadastral map to get the digitized data, such a way does not have a high accuracy rate, there may be some numerical deviations, for example, in the coordinates of some feature points and boundary points, there may be errors, so it is necessary to correct them with the method of retouching and patching again, through which the accuracy of the digitized cadastral map can be better improved.

#### (2) All-digital photogrammetry technology

The second is to obtain digital data by means of cam-

era, mainly through special aerial survey software to photograph the objects, and then form a digital model to match them, and then finally obtain a digital map through professional software, through which the shortcomings of scanning digital cadastral survey can be better compensated. In this way, a large amount of work carried out outside can be transferred indoors, and the work can be done more easily indoors. And by doing so, the pressure on staff can be better reduced, and the required data can be obtained in the fastest, then most accurate, and least expensive way. All-digital photogrammetry is sure to be an important direction for digital surveying in the future, so more needs to be done to improve this method of measurement.

In short, digital cadastral survey is not only to form a picture, but more importantly, to form a database, which contains many contents, mainly including some parcel data information, and some parcel area and street distribution, as well as coordinates of boundary points and coordinates of feature points, etc. Through this database, the government and relevant personnel can have a basic understanding of the land situation in China. The database will enable the government and relevant personnel to have a basic understanding of the land situation in China. The digital cadastral survey can be of great help in land management in China and therefore needs to be developed and improved.

## 3. Application in the Field of Construction Engineering

### 3.1 Analysis of Mapping and Digital Technology in the Field of Construction Engineering

#### 3.1.1 Information Technology

Digital surveying and mapping, due to the inclusion of advanced information technology, high degree of automation, thus the high level of operation in the construction project measurement, surveying and mapping products contain considerable information technology functions, but also according to the mapping of the situation to modify and supplement, to produce a new map to supply the use. In addition, the measured data can be automatically corrected to improve the quality of the mapping products. Digital mapping technology-related products are characterized by information technology at all stages of use.

#### 3.1.2 Graphics Processing Techniques

All of the mapping products of digital technology have graphic processing technology, which allows for relevant graphic processing according to different needs, including

stitching, scaling and even data reprocessing of various elements of the product. Graphics processing technology has greatly improved the usefulness of topographic maps and has also simplified the workflow, thus allowing for a large number of additional users and ultimately serving the purpose of improving business efficiency.

### 3.1.3 Digitization Techniques

Digital technology can play a key role in the accuracy of surveying and mapping compared to traditional surveying and mapping technology. The accuracy of mapping has been qualitatively improved, and the accuracy and practicality of the mapping results have been greatly improved. As the digital technology is used, the manual operation process is reduced, reducing the work error and ensuring the accuracy of the measurement results. On the other hand, in the process of implementing mapping, digital technology can also reduce the workload of staff, improve efficiency and reduce production costs.

## 3.2 Technology Applications and Their Development

### 3.2.1 Digital Mapping Techniques

In the past engineering mapping work, the mapping of large scale graphics and engineering maps have a very important position, but these mapping work requires large-scale field operations, which increases the workload and work intensity of surveyors and mappers, increasing the cost of engineering mapping, but the application of digital mapping technology can solve this problem. After continuous improvement and optimization of mapping technology, more and more perfect and mature, compared with the traditional mapping work, digital mapping does not require large-scale field work, which largely improves the efficiency of the map, reduce the work intensity of the surveyor, at the same time, is also conducive to improving the operating environment. As an emerging surveying and mapping technology, digital mapping has the significant advantages of small labor, convenient mapping, relatively high accuracy and high precision, and has been more and more widely used in the field of engineering surveying in recent years. In the current situation, digital mapping can be divided into 2 modes, one is the internal and external integration mapping, and the other is the electronic plate mapping. Among them, the internal and external integrated mapping is more widely used, and it is a more common means of data collection, with the significant advantages of clear division of labor, high accuracy, and high mapping efficiency.

### 3.2.2 Application of RS Mapping Technology

RS mapping technology refers to "remote sensing technology", which is mainly based on aerial photography technology, and then uses satellites to observe geographic information in real time. In the specific surveying and mapping work, the use of RS technology can achieve synchronous observation of geographic information in a large area, which largely ensures the validity and comprehensiveness of the data, which is of great significance to the measurement. Nowadays, RS technology has been widely used in construction engineering measurement, which can not only synchronize observation data in a large area, but also effectively collect small and medium scale graphic data, which has laid a good foundation for the measurement of urban basic graphics. It can be seen that RS technology has a pivotal role in construction engineering measurement.

### 3.2.3 Applications of Global Satellite Positioning Technology

The study of the application ideas of the new technology of surveying and mapping in construction engineering measurement, followed by the application of global satellite positioning technology. The application of global satellite positioning technology is not only used in engineering measurement, but also widely used in urban planning as well as engineering measurement. Global satellite positioning technology is an emerging discipline that integrates computer science, space science information science, mapping and remote sensing science, environmental science and management science. The application and development in many fields is enough to highlight its importance. The application of GPS in construction projects has revolutionized the change and development of mapping and positioning technology in China, and has extended the field of engineering surveying services in China to various sectors of economic development. The application of GPS has enabled comprehensive coverage of various information of engineering projects, improved the efficiency of engineering construction and reduced the construction period. The application of GPS in engineering projects prevents the loss of data, prevents data theft and improves the validity of data. Therefore, it is said that the application of GPS in engineering measurement can effectively improve the effectiveness of engineering measurement, and can realize the scientific, standardization and informationization of management.

### 3.2.4 Application of Photogrammetry Techniques

Photogrammetry refers to a technology that collects

the required data information through photography. With the continuous development of modern information, photogrammetry has been widely used in various fields, and gradually developed into digital photogrammetry technology. In the actual building surveying project, digital photogrammetry technology can often play an important role in dense areas of buildings, and efficient large-area mapping can provide surveyors with comprehensive urban building information, which greatly improves the efficiency of building engineering measurement. In addition, photogrammetric mapping technology also has the advantage of cost saving, in building construction as far as possible to save the cost of measurement and the use of labor, for the building construction side to save more money, to achieve better economic benefits.

### **3.2.5 Direction of Development**

In the level of technology continues to develop today, engineering measurement data is used before the measurement of the interactive scene of the measurement form, collected to remote control type. At the same time, the platform will also be based on the special requirements of the construction site measurement work, from fixed ground to airborne, satellite control, and gradually from static to dynamic, greatly improving the flexibility of measurement. For some large and more complex building structures, three-dimensional measurement of construction projects, modern industrial production automation, process control, product quality testing and monitoring data and positioning requirements. The accuracy requirements are getting higher and higher, and it is good to realize the extension of the three-dimensional measurement technology to promote human scientific measurement. Its main advantages can better promote the development of China's construction industry, and therefore at this stage has been widely used.

## **4. Application of Mapping Technology and Digitalization in the Field of Oilfield Surveying**

### **4.1 Steps in the Application of Digital Mapping Techniques**

The requirements of oilfield exploration projects are different, the objectives and programs of mapping are different, and of course the instruments used are also different. Generally speaking, in the preliminary stage of the exploration project, aerial photography (RS) technology can be used to map the work area, combine the various data information obtained from the mapping, have a pre-

liminary understanding of the work area, then design the point location of physical points, and then finally design a detailed mapping plan according to the workload, accuracy and other various requirements of the exploration project.

### **4.2 Measurement Methods**

When mapping in the field, you can first use global positioning satellite technology (GPS) to establish a GPS control network, analyze and process some static GPS data obtained in the field, and perform encryption operations on national control points, and use these control points as the basic control of the survey area, or use multi-base station network RTK technology to construct some reference stations, and upload the coordinates of the physical points that have been obtained to the mapping instruments. The relevant personnel can then carry out labeling, mapping and other tasks.

### **4.3 Data Processing Analysis**

Various data of digital mapping can be uploaded to the computer, and then the relevant personnel can use some professional software to organize, analyze and process these data accordingly. After the professionals have performed the relevant operations on the data, they can judge whether it meets the requirements. Since the data are digitized, they are easy to process, have fewer errors and are very efficient.

### **4.4 Practical Applications**

#### **4.4.1 Aerial Photography and Remote Sensing**

In the process of oilfield exploration, a preliminary understanding of the topography and other conditions of the study area should be carried out first before programme design and preparation of engineering operations can be carried out. In the past, staff were assigned to conduct in-depth site survey, which is not only time-consuming and laborious, but also the area of the survey is small and not deep and comprehensive enough, especially in some remote areas. The aerial survey of the study area by aerial photography (RS) can not only provide detailed topography and other conditions for the engineering project, but also various other information, such as traffic, water, vegetation, etc., which provides great convenience for the subsequent design and operation.

#### **4.4.2 Global Positioning System**

At present, global positioning satellite technology

(GPS) has been very widely used in all walks of life, and in oilfield exploration is no exception, especially the static post-processing technology, the main role of which is to build the control network of the study area and the static check of the end points of the survey line, to a certain extent, significantly improve the accuracy of mapping operations. Through the static post-processing technology, the mapping team can receive signals in real time, and carry out analysis and calculation to obtain accurate coordinate and elevation information, and according to the collection of various data, the use of relevant professional software can draw various drawings, which greatly improves the efficiency and quality of mapping.

#### 4.4.3 GIS

In addition to the above two technologies, GIS technology is also gradually applied in oilfield exploration, and its application is mainly divided into the following three aspects: ① drawing various maps, such as operation maps, topographic maps, traffic maps and obstacle maps, which can provide more scientific and practical reference for oilfield exploration operations; ② three-dimensional display of some maps, which can display the study area in a three-dimensional, multi-angle various situations; ③ processing and storage of some mapping data, and make it effectively applied.

In fact, the usefulness of geo-information technology is to enable the staff concerned to have geographical information about the mapped area and thus to make effective decisions. It is also called environmental information system and resource information system, because it is often used to reflect the current state of the Earth's environment and resources, and the rational application of modern technology and the organic combination of computer systems and database systems make the information obtained more comprehensive and complete and help staff to master and apply it, unifying the performance of remote communication equipment for remote sensing technology. Through scientific means to optimize the survey and positioning problems, to carry out real-time mapping work, enhance the authenticity of information resources, and strive for greater space for mapping work.

It can be said that the most widely used technology is GPS technology, which is actually global positioning technology, and this mapping technology is extended from positioning technology, which was initially applied in the military. In oilfield mapping, the reasonable application

of GPS technology can achieve dynamic monitoring of oilfield geology, because the continuous mapping, so that the effectiveness of mapping technology has been significantly improved, in order to provide accurate reference data for oilfield construction. In addition, in the actual mapping, GPS technology can completely cover the mapping project to ensure that the mapping work is all-round, and can transfer the measured data to the client in the first time, and the client can directly use the software to calculate the corresponding mapping results, effectively improving the quality and level of mapping work.

#### 4.4.4 Image Positioning Techniques

Some geology consisting of rocks requires a reasonable application of image positioning techniques if it is to be measured. The geological information is effectively processed through imagery and digitization to produce the final measurement results. In addition, some other emerging technologies can be applied, such as remote sensing imaging technology to joint application, such technology can effectively locate the impact, the geological measurement results and the surrounding links directly presented, compared with traditional technology, the information presented to be more specific, to facilitate the staff to fully grasp the geological conditions of the mine.

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